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Antikollisjonssystem

Thepres entinventio n relates toasys temfor co ntrolling the movementsof objectsinanautom ateds ystem comprisinginde pendent transportingmea nsfor moving anumb er ofobjec tsr elative toea chother, andamethodfor avoidingcollis ionsbetw een the objects,andtheus eof s uchasys tem.

In automatedor remote controlledsy stems comprising a number ofobjec ts moving partially independentof each other there is alwaysadange r ofcollisio ns between the objects.Oneexa mpleof a systemasde scribed above is systemsincludin g automaticor remoteopera tedmac hines involvedint .heoperation onadrillingr ig.A drillingr igcom prises ofse veraldiff erent machines.T he machinesare oftens pecially developed to fit the layoutonther igan d the strategy for operation, andmaybe moved inthesys temac cordingtotheir purpose.

Thetargetope rationf oradril ling rigisto drillwells onthe seabed. This is,verysimplified, donebyr otatingadril lstring,withadrilli ng-bit inthelowe rend ,and lowering itintot hesea bed.T hedr illstring consistsof several threaded pipesthatare connectedtogethe r.T hepipes are madeup/broke out inorderto prolong orshorten the drillstring. Consequently the mainoperation sonadr illingrig is to drill,move pipes between horizontaland verticalpipes toresand well centre, wherethedrillstringis rotated,and makeup/brea k out pipeswhe n connecting/disconnecting pipestoor fr om the drillstring. Thisr epresents a complexsy stemas thedif ferent parts mayhave differentweigh t,siz e,direc tion andveloc ity,an d may in additionber otatedas part of the operation. Ma nyof the objects may have complexge ometries,makin g iteve n harder topredic tthe exactroomtheyocc upyinthesys tematallt imes.During complex operationsthe re is a dangerthattheope ratorloos etheovervie w ofthesitu ation, increasing the chances ofcollis ion.A collision may occurif theope rator makes simple mistakes such asamisinte rpretationof pos itiondata,theori entation ofanobjec t orif the objecthas shiftedslightlyrelative toitsregis teredloca tion.

Asolu tion tothis would be to slowt heoperation down soastomainta in the overviewof the system,or to uselargesa fety marginswhic h alsoreduc es the speed and efficiencyof thesys tem, especiallywhe noperation sareperfor medin areas with limitedsp ace,su chas drill rigs at sea.

Thus itisanobjec t ofthisinven tion toprovide a system that allows severalobje ctstomove within a system without risking collisionsor ac cidents,

providing an increasedefficienc yto the system whenco mparedtotheprevious ly known systems. Thisobje ctisobtaine d by a system asdes cribed intheac companying independentclaims .

Thesys temac cordingtotheinven tion thuspr ovides a simpleand effective system whichdoes not demandlarge calculationpowe rs inope ratingasys tem, asit keeps track ofgeom etricalobje ctsbein g relatedto controllable positiondata for each objectin the system,e.g. havingsimplified shapeswhich may giveanextratolera ncein the stored positionda ta andwhich are easy tovisu alise on a computersc reen. In addition,atolera nceisprovide d aroundtheobjec tsand routinesarees tablishedf or relating a setof rules for the relativemove ments oftheobje cts.

Theman agementsys temr elated tothisinve ntionwill be referred tobelow as a SmartZoneM anagement System(SZMS)

Theinve ntion will be describedbelow withreferenc eto theacc ompanying drawings, illustratingtheinven tion by wayof ex ample.

Figure1: illustratesapipe handlingsys temsuita blefor implem entation ofthe invention.

Figure2: illustratesano ther pipehandlin g system suitable for implementationof the invention.

Figure3: Principledraw ing oftwomac hines representedbyboxes . Themac hines are travelling towardsea chothe r.

Figure4: Principledraw ing oftwomac hines representedbyboxes . Machine1 is moving towardsmac hine2. Machine2ismovingaw ayf rommac hine1.

Figure1 illustrates an exampleof asy stem onadrill rig, inwhic h the system according totheinve ntion maybeuse d.

In horisontaltovertica l pipehandling systemthepipes (singles)12are usuallystored horizontallyand assingle son pipedeck11. A commonconfiguratio n of machines13, 15,18 usedtotr ansportpipebe tween pipedeck(horizontally)andthe drillingr ig(vertica lly)17areapipera ckcrane 13 incom binationwithatubula rfeed ing machine 18an d an EagleL ight/HTV-Arm 15.

As is clearf romthisex ample the pipe handling system comprisesa number ofelem entthatmayope ratef airlyinde pendentof ea chothe rsotha t collisions may occur. Also ,thediff erent machineswilltake up differentvolume sof spacee.g.

whent hecrane picksupapipe.S omeof the parts ofthesys temmay alsor otatesuc has the pipes12,14beingmove d fromahorizonta l toavertica l position, andthus occupying a differentspa ce afterthan before the operation.

Figure2 illustrates a verticalpipeha ndlingsys teminvolving machinesto move stands21 (usually2or 3made up singlepipe s) verticalin thederr ickbetwe enthe vertical store(setbackand fingerboard)22,24and well center(WC)26isusua lly a part of a drillingrig. This is a commoncon figuration knownas a "Vertical Pipehandling Two-Arm Syncro system"(VPH). ThisVPHsys temcompris esof one bridgecrane 23 mountedin the derrick andonelowe rguidin g arm25mounte don drillfloor. The drawing alsosho wsaroughne ckfor sc rewingthe stands 21 tothepipe salread y positionedinthewellce ntre26. T husthissys temmove sthesta ndsoutof the vertical store onto the pipesinthewellce ntre.

As stated abovethema in purposeof thisi nvention istoavoid collisions between machinesthataremem bersof the system.R eferring alsoto figure 3thisis obtainedbyr elatingea chpartof the system toan imaginary3- dimensionalobje ct 1,2,3 havingadefinedge ometricsha pecorres ponding toor exceedingthephys ical dimensions ofthepa rtin all directions. The imaginaryobjec t 1,2,3 is alsoas signedto position dataco rresponding tothephys ical positionof the relatedmac hinepart, so that it maycontrolthemove ments oftheobjec tsin a modelof the real situation,wherein the model mayincorporate all relevantinfor mationabou t fixedan d movingobjec tsin the relaworld. Thusma chine M1i n figures 3an d 4ma y thusr epresent a crane1holdinga horizontalpipe2 movingtowardthedrill rig3, M 2.

E achgeo metricsha peor box 1,2,3 maycons istof several rectangles providing the approximate shape oftheobje ct,an d mayalsorotate ,e.g. co rrespondtoa pipe beinglif ted froma horizontaltoavertica l position. Thus the boxes are dynamic and reflect the machinespos itionandexte nt inthe system.I fboxe sr eflectingdiff erent machinesarein conflict, (sharing roomintheCa rtesian coordinate system) aco llision hasocc urred.Allmach ines must relateto the same Cartesiancoo rdinatesys tem.T he Cartesian coordinate systemcan be orientedwithpositive x-axisf romwe llce nter toward V-door, positive y-axisf romwellce ntert owardf ingerboardand positivez-ax is from drillfloor and upward.

In additionea chmac hineM 1,M2 is relatedto a stopdista nce(dista nce needed tocom et o a complete stopi n a controlledmann er)for ea chax is in the Cartesian co-ordinatesys tem. The stopdistan ces are theactua l distancenee dedtostopthe machine atthe presentsp eedan d loadi n the givendir ection,andmay depend oft he weight ornumbe r ofpartshand ledbyeac h machine, asin the machine M1comp rising twoparts 1,2. Thes top distances are usedinthesys temor methodac cordingtot he inventionto ramp down andstopthe machinesbeforecollis ion occurs.Aminimise function is implemented in the machine programmable logic controller(PLC) tomak e sure that the least ofcomma ndvalue from operator(e.g.joystic k)an d allowed value (calculated in the system)isus edf ormac hineco ntrol.

Figure3 showsa principledrawing oftwomach ines representedby boxes. Box 1 and box 2 representma chine 1, box 3 represent machine 2.X1 is theminimum distance betweenthetwomac hines alongthex-axis (atagiven moment).X2isthe distance thesys temuse sto ramp downandstop machine 1(derived from stopdista nce calculatedin the machineP LC).X4i s thedistan cethes ystem uses torampdown and stop machine 2.I n figure3t hetwomach ines are travellingt owards eachothe ralo ng the x-axis.If mac hine1or machine 2 iss tandingstillor travellingin the opposite direction, X2an d X4 would bezero(r espectively). X5 is the safety distancebetwe enthetwo machinesalongthex-axis .As the machinesaretrave lling towardsea chothe rX3will decrease. When X3=X5SZ MS startstor amp downthemac hines.Themac hines will cometo a complete stopwitha distanceof X5 betweenthem(alongthex-axis).T he sameca lculationsand evaluationswill bedonefor y-axisandz-axis .

In figure4mac hine2ismovingaw ayf rommac hine1(alongthex-axis) and machine 1 is moving towardsmac hine 2. X1 is the minimumdistan cebe tween the twomac hinesalongthex-axis (atagive n moment).X2isthe distanceS ZMSus es to rampdown and stopmac hine1(derivedfr oms top distanceca lculated in the machine PLC).X5isthesa fetydista ncebe tween the two machinesalon g the x-axis. X6 is the distance SZMSus estor ampupt hespe edf ormac hine1(from0 tofull speed) alongthe x-axis.If bothmac hineshave cometo a completestopand machine 2sta rts to move awayf romma chine 1, SZMSramps up the speed formach ine1 (followfunction).

It is clearthattheabov ementionedobje cts1,2, 3 alsomayrepres ent unmoveablestructures such asthedril lrig 17,soas to avoidcollision sbetwe enthe machinesandtherestof thei nstallation.

Allopera tors operatingmac hinesi n the system according to the invention willhave visualisationme ans available,e.g. relatedto a humane machine interface (HMI). TheHM I visualisesif the machineshav estoppe d(orarespe edlimited)dueto actionstak enbyt hesys tem. Throughthis interfaceit is possible to manually neglect/disregardmac hinesf romtheman agementsys tem(SZMS). Thus machinesmay be removedf romthes ystem,e.g. if an errorhas occurred, sothatanopera tion may continue.

Collisionbetw eenma chinesandrig structureetc may be handled by the presentinven tion asanadd itionalf eature.T he systemi snot only handlingmac hine specifican tico llisionsc enarios relatedtomach ineposition ,butalso scenariosr elated to handlingof pipe etc (e.g. donothois t if both elevatoran d roughneck clampislocke d onpipe). Exceptions fromzone management control are alsobehan dledbythepres ent invention (e.g. one machineallowe d todis regardanothe r machinesprese nce inan area due tositua tions that frequently occur, andaresupp osed tooc cur,innormaloperatio n).

Thedyna micboxe shave chosengeome tric shapeandchos endime nsions representing eachma chine.Thecontrolsys temac cordingto thepr esent invention makes sure that thereisasafety distance(but notmuc h more)be tween the boxes (machines).A machinecanfollowanoth er machine aslongas the distancebetwe en them are greatert hanthesa fety distance.

Thesys teman d methodac cordingto thei nvention may be madeus ing any available softwareand hardwaretools ,aperso n knownin the art being abletochoo se the system most suitable toea chsitua tion, for exampledepe ndingonotheralread y available equipment on the site. Althoug h the system asdes cribed is based on knowledge ofthepos itionsof the moveableobjec tsthesys temmayals oi ncorporate sensors giving feedbackto thesys temaboutthewhe reaboutsandorienta tionof ea ch object, so asto provideanextrase curityaga instcollis ionsdue toerroneo usor unregistered shifts inthe positions. Alternatively the system mayof co ursebe monitored visuallyinaddition tosho wingtheimagina ry objects on a screen,sothatan operator may obtainanadd itionalcontrolof the situation.

C l a i m s

1. System forcontrollingthemove ments ofobjec tsin anautoma tedor remote operated system comprisinginde pendenttr ansportingme ans for moving a number ofobjec tsr elative toea chother, the system beingprovidingwithmea nsfor controlling the positionandve locityof the objects relativeto each other,whe rein each objectisr elated toadefined geometricsh ape relatedto the objectpos itionshav ing dimensions correspondingto orexc eedingthephys icaldimen sions oftheobjec t in all directions, andalso defining a criticalallowe d distancebetw een the definedgeom etric shapes.

2. System according to claim1, whe rein the dimensionsof the geometric shape correspondsto the size oft heobjec t.

3. System according to claim1, whe rein saidcritica l distanceisdepe ndent ontherelative movement betweentheobjec ts.

4. System according to claim1, whe rein the criticaldista nce between two geometricsha pes movingtowardea chothercorresp onds tothebrakingdis tancef or eachcorres ponding objectpluss a chosenaddition aldistan ce.

5. System according to claim1, whe rein the objectsandcorres ponding geometricsha pes are adaptedto be rotatable.

6. System according to claim1, whe rein the geometric shape is rectangular.

7. Methodfor avoidingcollis ionsbetw een automaticallycontrolled or remote operated objects havingvariable positions andmovem entsrela tivet o each other saidpositions andmove ments beingcontrolled byacon trolsy stem,compris ing assigning a geometric shape toea chobje ct,sa idgeome tric shape correspondingto or exceedingthedimen sions ofthecorres pondingobje ct, the geometrics hape thus occupying a spacecorresp ondingto orexc eedingthespa ce occupied by the object,and defining a critical minimumdistan cebe tween saidgeom etricalsh apes.

8. Methodac cordingtoclaim7, whereinthedime nsionsof thege ometric shape correspondsto the size oft heobjec t.

9. Methodac cordingtoclaim7, whereinsa id criticaldista nce is dependent ontherelative movement betweentheobjec ts.

10. Methodac cordingtoclaim7, whereinthecritica l distancebetw eentwo geometricsha pes movingtowardea chothercorresp onds tothebrakingdis tancef or eachcorres ponding objectplusach osen additionaldis tance.

11. Methodac cordingtoclaim7, whereintheobje ctsan d corresponding geometricsha pes are adaptedto be rotatable.

12. Methodac cordingtoclaim7, whereinthege ometricsha peisrecta ngular.

13. Useof a system according tocla im 1onoff shoreinsta llations,es pecially for handlingpipes in drillingoperatio ns, whereinsa id objects correspondstomean sf or storing,movingand /orins tallingequipm entin the installations.

14. Useacc ordingto claim13, whereintheinsta llations is a drillr igan d the system is usedfor sto ring,movingand installingpipes on a drillr ig.

Abstract

Thisinve ntion relates toasy stemfor controlling the movementsof objects inanautom atedor remoteopera tedsys tem, aswellas a relatedmetho d anduse ofthe system compris ing independenttrans porting meansf ormovinganumbe r ofobjec ts relative to each other,thesys tembeing providing with means for controllingthe position andveloc ity oftheobje ctsrelative to eachothe r. Each objectisrelate dt o a defined geometric shape relatedtotheobjec t positions havingdimens ions corresponding toor exceedingthe physical dimensionsof the objectinall directions, and alsodefiningacritica l allowed distancebetwe enthedefine d geometric shapes.

Figure3

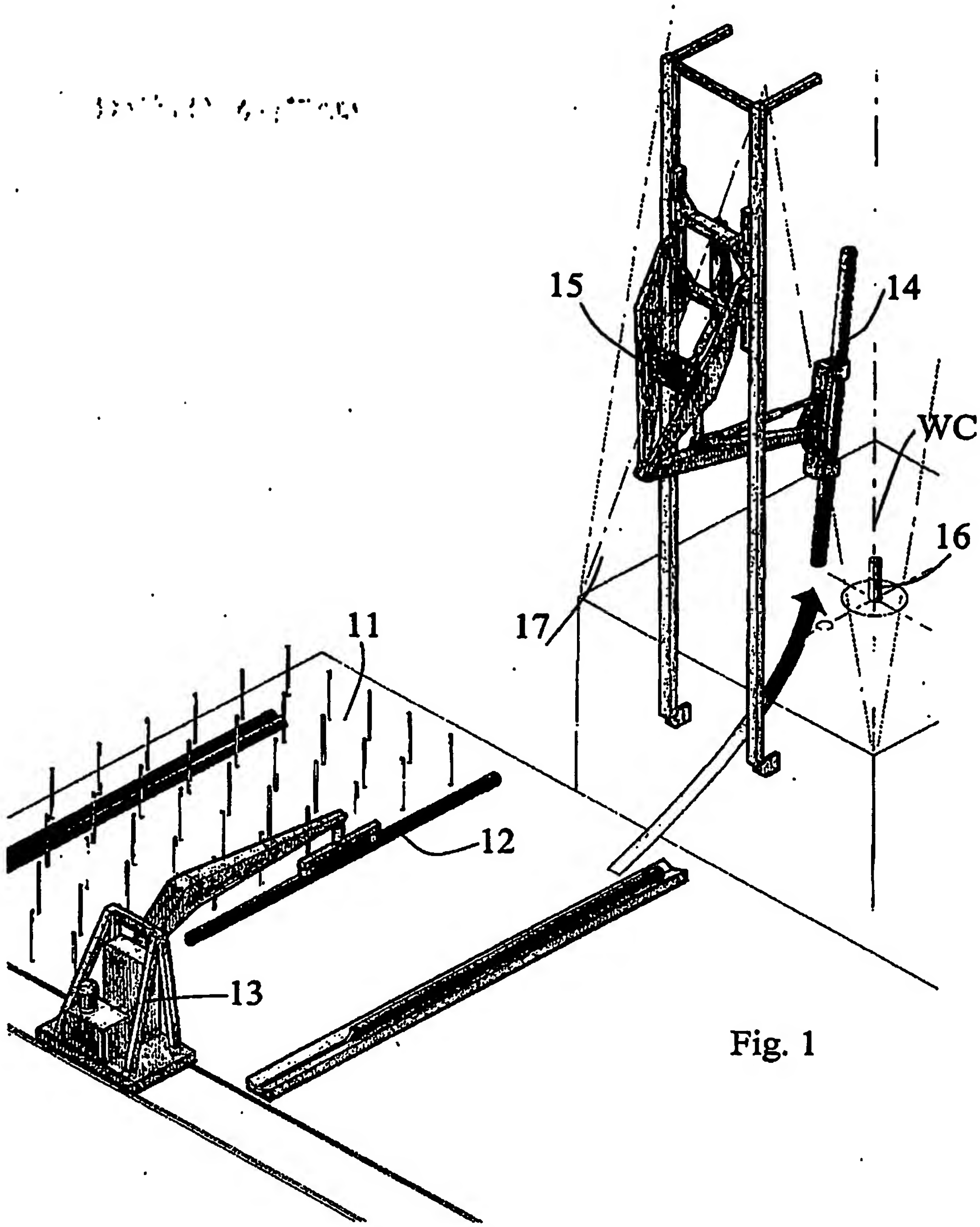
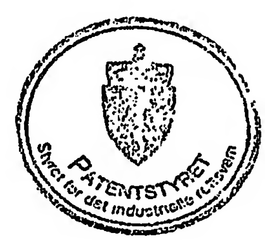

15
14
WC
16
17
C
11
12
13

Fig. 1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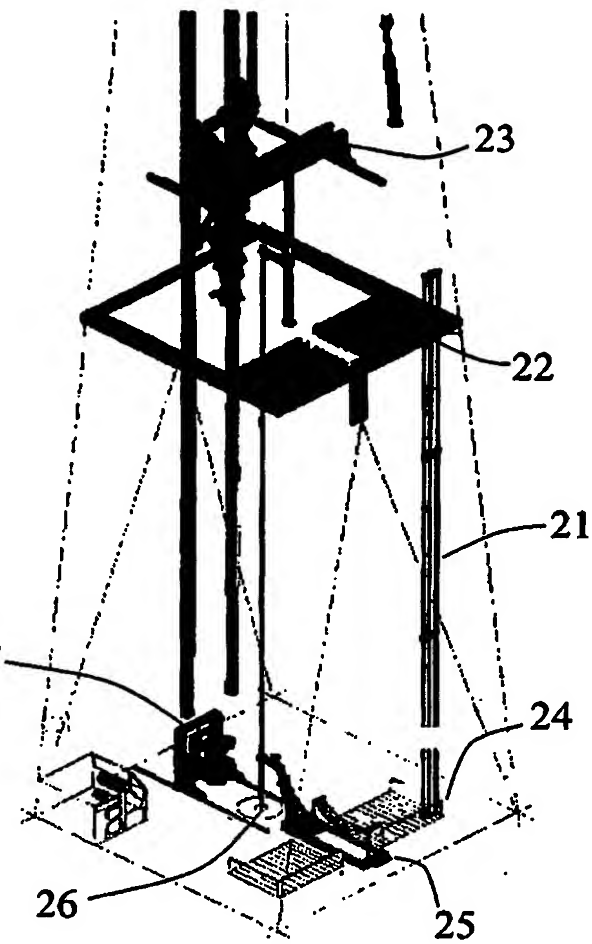

Fig. 2

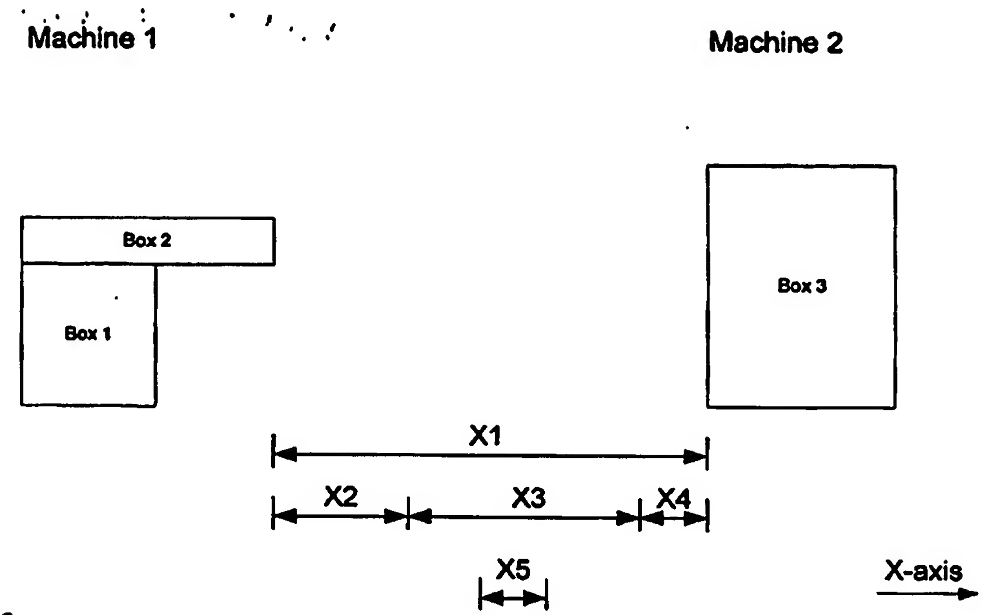

Figure 3

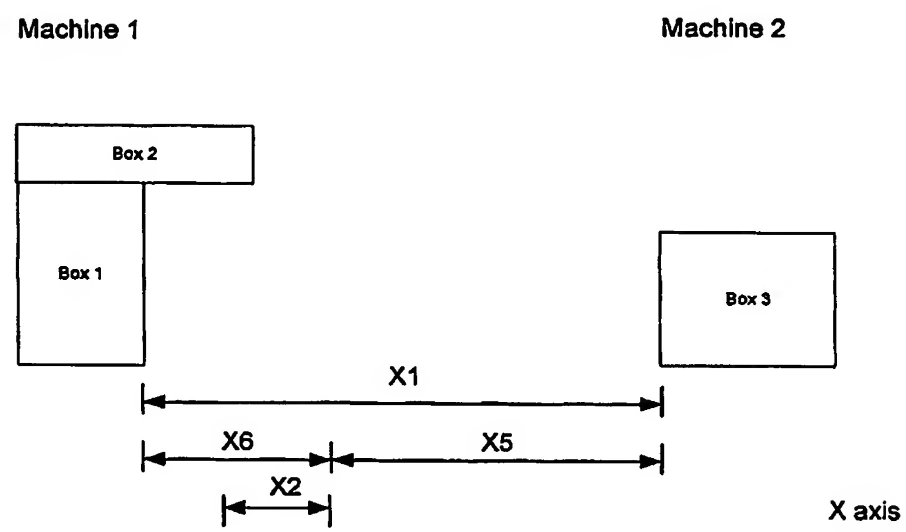

Figure 4